

**WHAT IS CLAIMED IS:**

1. An optical cross-connect device for communication between first and second optical networks communicating with each other using forward and backward optical signals each comprising a plurality of channels, said optical cross-connect device  
5 comprising:

a first circulating part having first through fourth ports configured to output an optical signal which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port, the first circulating part being connected at the first and third ports thereof to a first optical network;

10 a second circulating part having first through fourth ports configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port, the first circulating part being connected at the first and third ports thereof to a second optical network while being connected at the second and fourth ports thereof to the second and fourth ports of the first circulating part,  
15 respectively;

a first reflecting part connected to respective second ports of the first and second circulating parts, and adapted to selectively (1) reflect each channel of a forward optical signal input thereto; and (2) allow the channel to pass therethrough; and

a second reflecting part connected to respective fourth ports of the first and second  
20 circulating parts, and adapted to selectively (1) reflect each channel of a backward optical signal input thereto; and (2) allow the channel to pass therethrough.

2. The optical cross-connect device according to claim 1, wherein each of the first and second reflecting parts comprises a plurality of fiber Bragg gratings (FBG), each of which being adapted to allow an optical signal input thereto to pass through or reflect only a predetermined channel of the optical signal in accordance with an ON or OFF state thereof.

3. The optical cross-connect device according to claim 1, wherein the first circulating part comprises:

a first circulator having a plurality of ports including the first and second ports of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a second circulator having a plurality of ports including the third and fourth ports of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

wherein the first and second circulators are connected to each other in a double-port-connected configuration.

4. The optical cross-connect device according to claim 1, wherein the second circulating part comprises:

a first circulator having a plurality of ports including the first and second ports of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-

order port; and

a second circulator having a plurality of ports including the third and fourth ports of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

wherein the first and second circulators are connected to each other in a double-port-connected configuration.

5. The optical cross-connect device according to claim 1, wherein the first circulating part comprises:

a first circulator having a plurality of ports including the first port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a second circulator having a plurality of ports including the second port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a third circulator having a plurality of ports including the third and fourth ports of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

wherein the first through third circulators are port-connected to one another.

6. The optical cross-connect device according to claim 1, wherein the second circulating part comprises:

a first circulator having a plurality of ports including the first port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a second circulator having a plurality of ports including the second port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a third circulator having a plurality of ports including the third and fourth ports of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

wherein the first through third circulators are port-connected to one another.

7. The optical cross-connect device according to claim 1, wherein the first circulating part comprises:

a first circulator having a plurality of ports including the first port of the first circulating part while configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a second circulator having a plurality of ports including the third port of the first circulating part being configured to output an optical signal, which is input to a higher-

order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a third circulator having a plurality of ports including the second and fourth ports of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

wherein the first through third circulators are port-connected to one another.

8. The optical cross-connect device according to claim 1, wherein the second circulating part comprises:

a first circulator having a plurality of ports including the first port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a second circulator having a plurality of ports including the third port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a third circulator having a plurality of ports including the second and fourth ports of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

wherein the first through third circulators are port-connected to one another.

9. The optical cross-connect device according to claim 1, wherein the first circulating part comprises:

a first circulator having a plurality of ports including the first port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a second circulator having a plurality of ports including the second port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

a third circulator having a plurality of ports including the third port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a fourth circulator having a plurality of ports including the fourth port of the first circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

wherein the first through fourth circulators are port-connected to one another.

10. The optical cross-connect device according to claim 1, wherein the second circulating part comprises:

a first circulator having a plurality of ports including the first port of the second circulating part being configured to output an optical signal, which is input to a higher-

order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

5 a second circulator having a plurality of ports including the second port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port;

10 a third circulator having a plurality of ports including the third port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port; and

a fourth circulator having a plurality of ports including the fourth port of the second circulating part being configured to output an optical signal, which is input to a higher-order port thereof, from a lower-order port thereof arranged adjacent to the higher-order port,

15 wherein the first through fourth circulators are port-connected to one another.